



TENNESSEE DEPARTMENT OF

**EDUCATION**  
FIRST TO THE TOP

## Architectural & Engineering Design III

<b>Primary Career Cluster:</b>	Architecture & Construction
<b>Consultant:</b>	Rachel Allen, (615) 532-2835, <a href="mailto:Rachel.Allen@tn.gov">Rachel.Allen@tn.gov</a>
<b>Course Code(s):</b>	5927
<b>Prerequisite(s):</b>	<i>Architectural &amp; Engineering Design II</i> (6039), <i>Geometry</i> (0843, 3108)
<b>Credit:</b>	1-2 credits (see Recommended Credit below)
<b>Grade Level:</b>	11-12
<b>Graduation Requirements:</b>	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
<b>Programs of Study and Sequence:</b>	This is the third course in the <i>Architectural &amp; Engineering Design</i> program of study.
<b>Aligned Student Organization(s):</b>	SkillsUSA: <a href="http://site1.tnskillsusa.com/">http://site1.tnskillsusa.com/</a> Brandon Hudson, (615) 532-2804, <a href="mailto:Brandon.Hudson@tn.gov">Brandon.Hudson@tn.gov</a> Technology Student Association (TSA): <a href="http://www.tntsa.org">http://www.tntsa.org</a> Amanda Hodges, (615) 532-6270, <a href="mailto:Amanda.Hodges@tn.gov">Amanda.Hodges@tn.gov</a>
<b>Coordinating Work-Based Learning:</b>	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit <a href="http://tn.gov/education/cte/work_based_learning.shtml">http://tn.gov/education/cte/work_based_learning.shtml</a> .
<b>Available Student Industry Certifications:</b>	Autodesk Certified User or ADDA Apprentice Drafter
<b>Dual Credit or Dual Enrollment Opportunities:</b>	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
<b>Teacher Endorsement(s):</b>	070, 157, 230, 470, 477, 531, 551, 552, 553, 554, 555, 556, 584, 585, 595, 596, 700, 705, 740, 760, or any other Occupational License endorsement with ADDA certified drafter or Autodesk certification
<b>Required Teacher Certifications/Training:</b>	ADDA Certified Drafter or Autodesk Certified Professional
<b>Teacher Resources:</b>	<a href="http://www.tn.gov/education/cte/ArchitectureConstruction.shtml">http://www.tn.gov/education/cte/ArchitectureConstruction.shtml</a>

### Course Description

*Architectural & Engineering Design III* is the third course in the *Architectural & Engineering Design* program of study. In this advanced course, students will apply technical drawing and design skills developed in the previous courses to specific architectural and mechanical design projects and contexts. In the process, students will expand their problem-solving and critical-thinking skills by assessing the

requirements of a project alongside the available resources in order to accomplish realistic planning. Upon completion of this course, proficient students will be able to employ methods of data collection and analysis to provide others with appropriate information for projects and to develop their own designs. Students will also be able to engage with industry-specific technology to create visual representations of project outcomes. In addition, students will continue compiling artifacts for inclusion in a portfolio, which they will carry with them throughout the full sequence of courses in this program of study. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.\*

## Program of Study Application

This is the third course in the *Architectural & Engineering Design* program of study. Flexibility is built in to offer this course for either one or two credits, depending on school capacity and teacher background. Whether offered for one credit or two credits, this course can feed into a fourth-level *Engineering Practicum* course in which students can apply the skills learned toward the completion of an in-depth, semester- or year-long project. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at <http://www.tn.gov/education/cte/ArchitectureConstruction.shtml>.

## Recommended Credit

If all standards in the course are covered, the course is recommended for two credits. If only one credit is to be offered, the following two options are recommended:

### 1 Credit- Option A

Content	Standards
Safety	1, 2
Architectural Design	3, 4, 5, 6, 7, 8, 9, 10
Research Project	16
Design Project	17, 18, 19
Project Management	20, 21, 22
Portfolio	23

### 1 Credit- Option B

Content	Standards
Safety	1, 2
Mechanical Design	11, 12, 13, 14, 15
Research Project	16
Design Project	17, 18, 19
Project Management	20, 21, 22
Portfolio	23

## Course Standards

### Safety

- 1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. (TN Reading 3, 4, 6)
- 2) Identify and explain the intended use of safety equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with tools

and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3, 4)

## **Architectural Design**

- 3) Interpret civil drawings used to describe a site, including recognizing symbols used to describe topography. For example, in teams, interpret a topographic survey drawing to construct a model (physical or virtual) of a building site. Use the model to influence the design of the building and the building's placement on the site. (TN Reading 3, 4, 5, 6; TN Math N-Q, G-GMD, G-MG)
- 4) Perform a site analysis to make design decisions for a building plan, including interpreting existing site conditions and evaluating site surroundings. Determine the impact environmental factors such as climate, wind patterns, and the movement of the sun have on the design and site placement of the building. Summarize site analysis findings with drawings and supporting text. (TN Reading 2, 3, 4, 5, 7; TN Writing 4, 9)
- 5) Synthesize the various constraints affecting a building's design to make and justify design decisions. Items to consider should include:
  - a. Evaluating the building's program based on client need. For example, appraise the requirements of the client such as total square footage and list of desired features (number of bedrooms, bathrooms, etc.).
  - b. Accommodating the needs of people of all ages and physical abilities in compliance with the Americans with Disabilities Act (ADA).
  - c. Interpreting applicable building codes based on the project type. For example, determine the minimum number and spacing of exit doors for a given building occupancy size.(TN Reading 2, 4, 6)
- 6) Research planning and diagramming techniques used by designers. Implement planning and diagramming techniques such as bubble diagrams and traffic flow patterns to design a schematic site plan and floor plan for a given building program. (TN Reading 2, 3, 4, 7)
- 7) Create a properly scaled model of a building (physical or virtual) and study the model in the context of the site layout. Present the model along with supporting sketches and diagrams to an audience (such as the instructor and peers), explaining and justifying design ideas in a logical, coherent narrative. Gather feedback and use it to refine the design. (TN Reading 3, 4, 7; TN Writing 2, 4, 5, 9)
- 8) Incorporate schematic design sketches, models, and peer feedback to further develop a building's design. Communicate details of the design through appropriate drawing types, utilizing industry-standard drawing conventions and software. Create a comprehensive set of drawings including the following drawing types:
  - a. Site plan
  - b. Floor plan
  - c. Interior and exterior building elevations
  - d. Foundation plan
  - e. Roof plan
  - f. Building system plans (such as an electrical plan)

- g. Door and window schedules
  - h. Three-dimensional renderings (interior and exterior)
- (TN Reading 3, 4, 7; TN Math N-Q, G-GMD, G-MG)

- 9) Research sustainable design solutions and practices; then provide recommendations for a given design. Calculate a rating for energy responsiveness using a sustainable building guideline. (TN Reading 2, 3, 4, 6; TN Writing 7, 9)
- 10) Examine a wall section drawing for a specific building. Identify, define, and explain the function of each component, including wall insulation, flashing, and the structure of the cornice. Draw from textbooks and other resources to annotate the wall section drawing with notes explaining the purpose of each component. (TN Reading 1, 2, 3, 4; TN Writing 2, 4, 9)

### **Mechanical Design**

- 11) Create three-dimensional models of machine parts of increasing complexity utilizing parametric modeling software. Perform software operations including:
- a. Utilizing basic software tools such as extruding and cutting, and navigating around the object.
  - b. Applying and modifying geometric constraints and dimensions to capture and alter the design geometry of a part.
  - c. Creating drawing layouts with dimensioned views of parametric solids, arranging a drawing sheet according to industry standards.
  - d. Printing drawing layouts at appropriate scales.
  - e. Preparing multi-sheet working drawings and assembly drawings according to industry standards.
- (TN Reading 2, 3, 4; TN Math N-Q, G-GMD, G-MG)
- 12) Building on techniques practiced in prior courses, continue to measure, record, and use field measurements to create drawings of increasingly complex objects and layouts. For example, create an accurate three-dimensional model of an actual screw and fastener by first measuring and examining the physical object in order to visualize and create the model. (TN Reading 3, 4; TN Math N-Q, G-MG)
- 13) Compile parametric models of individual machine parts to create a model of a simple assembly. Perform advanced software operations such as animating the model to illustrate how the assembly operates. (TN Reading 3, 4; TN Math N-Q, G-GMD, G-MG)
- 14) Utilize the design process to create a schematic design solution for a mechanical design problem. Identify the criteria and constraints and produce a virtual or physical model of the solution, utilizing software tools where appropriate. Test and evaluate the solution by performing an analysis of the model and gathering feedback from peers. (TN Reading 2, 3, 4; TN Math N-Q, G-GMD, G-MG)
- 15) Incorporate schematic design models, peer feedback, and test results to further develop a design. Communicate details of the design through appropriate drawing types, utilizing industry standard drawing conventions and software. Derive working drawings (detail and assembly

drawings including parts lists) from the three-dimensional models created using parametric modeling software. Attend to details when explaining the design, including:

- a. Specifying and depicting threads, fasteners, and other hardware involved in a mechanical assembly.
- b. Applying appropriate geometric dimensioning and tolerancing based on industry standards, including understanding tolerance relationships between mating parts, interpreting geometric tolerancing symbols in a drawing, and using tolerancing in drawings.
- c. Selecting and creating appropriate section drawings, noting tolerances, hidden surfaces, and other mechanical details.

(TN Reading 2, 3, 4, 7; TN Math N-Q, G-GMD, G-MG)

### **Research Project**

- 16) Employ basic methods of data collection and analysis to compile information for projects. Use available research methods when project planning and problem solving. Synthesize research to present appropriate precedents for development of a project and articulate logical rationale for the use of chosen precedents. Create a detailed presentation or written report, citing evidence from research. Examples include a proposal for how a specific plot of land should be developed to meet the needs of a given neighborhood; or a proposal for a new product based on consumer market data for a target audience. (TN Reading 1, 2, 4, 6, 9; TN Writing 1, 4, 8, 9)

### **Design Project**

- 17) Use the design process to create schematic designs employing discipline-appropriate representational media (such as sketches, technical drawings, and preliminary models) for a given problem set. Prepare and present schematic designs to peers and others, citing research to justify design solutions. Note constructive feedback received and use it to refine the design. (TN Reading 1, 2, 3, 4, 7, 8, 9; TN Writing 1, 4, 5, 9; TN Math N-Q, G-GMD, G-MG)
- 18) Drawing on results from the schematic design phase, create discipline-appropriate drawings based on industry standards, a three-dimensional model of the design, and presentation boards. Present final design conclusions to members of the profession as well as peers; justify design decisions as would an architect or engineer delivering a pitch to a prospective client. (TN Reading 2, 3, 4, 9; TN Writing 1, 4, 5, 9; TN Math N-Q, G-GMD, G-MG)
- 19) Compile working drawings in a comprehensive set, including a bill of materials with allowable material alternatives. Demonstrate the ability to properly select the drawing scale, select the views, lay out drawings, and organize the drawing set according to industry standards. (TN Reading 2, 3, 4; TN Math N-Q, G-GMD, G-MG)

### **Project Management**

- 20) Examine how architects and engineers conduct project management processes, including but not limited to setting interim goals, tracking progress, and coordinating with construction professionals and clients. Compare and contrast components of project management models gathered from textbooks, online resources, and actual case studies of major or local design professionals. (TN Reading 7, 9; TN Writing 4, 8)

- 21) Utilize project management strategies to create and implement a work plan to complete projects according to schedule. Use technology to periodically document project status and progress in written reports. (TN Reading 3, 4; TN Writing 2, 4, 6)
- 22) Create a written report or infographic describing the basic steps of traditional project delivery, outlining who and what is involved in each step. Compare texts to describe alternatives to traditional project delivery methods, such as the design-build method used in construction. (TN Reading 1, 2, 4, 5, 7; TN Writing 2)

## Portfolio

- 23) Update the portfolio to reflect the cumulative total of all projects undertaken across the program of study. Continually reflect on coursework experiences and revise and refine the career plan generated in the introductory course. Include written descriptions of drawing types and learning outcomes. (TN Writing 4, 5, 7, 9)

## Standards Alignment Notes

\*References to other standards include:

- TN Reading: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: [Tennessee State Standards for Mathematics](#); Math Standards for High School: Number and Quantity, Geometry (pages 58-83).
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.